

## Rymer, Edwina

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**From:** Ben Grunewald <ben@gwpc.org>  
**Sent:** Monday, August 31, 2015 2:08 PM  
**To:** Dellinger, Philip  
**Subject:** FW: Final primer courtesy read  
**Attachments:** Preliminary\_0831.pdf

[Hey Phil – please see Bill’s comments below and attached is the latest version of the Annual Forum Agenda...](#)

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**From:** Bates, William [mailto:bates.william@epa.gov]  
**Sent:** Monday, August 31, 2015 10:06 AM  
**To:** Ben Grunewald <ben@gwpc.org>  
**Subject:** RE: Final primer courtesy read

Good morning Ben,

Thank you for the opportunity to review the latest version of the primer.

In general, I think that is version of the primer is very good. The organization and the flow of the document works very well. I do have several comments for your consideration. Please see below.

General:

There are several instances of grammatical (punctuation on the wrong side of parentheticals and run-on sentences) and formatting (indenting where none is needed) issues and incorrect citation with the document. I think a fresh pair of eyes would help catch these issues.

Terms that are related to disposal wells are not defined in the glossary. I would suggest adding those words to the glossary. For example, in appendix b, you talk about surface casing and long string and production string, but these terms are never defined.

Executive Summary:

In the risk management section (last full paragraph), you list out some options for mitigation. In that list several of them could fall under permit modification, yet you also add permit modification to the list. Permit modification to me is not really a mitigation step. It is one mechanism to get your mitigation approach in use, but it is not really a mitigation approach in its own right.

In the external communication section, I think that there should be some mention of anxiety/nuisance issues.

Chapter 1:

The way that Walsh and Zoback is cited in the highlight section seems odd to me. That bullet does not really have findings from their work and I am sure that other researchers are doing similar studies. If you are wanting to use them as an example of work being done, it might be help to indicate that.

Under the introduction number two is an overly simplistic statement and may lead to confusion.

Under the introduction number three c is an incomplete sentence.

Under number four in the introduction, it would be helpful to define very small in magnitude.

In the fifth paragraph on page 14, second sentence 2003 should be changed to 2001. Also the last sentence in this paragraph seems out of place.

Under the Estimated Number of Induced Seismicity Locations section you mention the National Research Council’s report on seismicity. In that paragraph you state “...NRC had identified 156 global locations where induced seismicity was suspected...” you further go on to say “Geothermal projects and reservoir impoundment projects ... account for a significant portion of these cases (69 locations).” This seems a bit disingenuous to me. Out of the 156 you mention the 69 that are related to geothermal etc. That leaves 87 locations, which out of that, I got 68 that were associated with oil

and gas related activities. Why not just state that NRC identified 68 locations where oil and gas related activities were suspected to be associated with seismic activity?

#### Chapter 2:

The first mention of pounds per square inch is as an abbreviation. I would suggest writing it out.

It is unclear how the third paragraph on page 29 fits with the other material that is presented.

Under the Further analysis to evaluate causation section you mention that the regulatory agency may need to serve as a facilitator with the operators. It is unclear to me who the regulator will be facilitating between? Between different members of industry? Between other agencies and industry? Between the public and industry? Please clarify.

#### Chapter 3:

It seems odd to me to be referencing an appendix in the highlight section. I would suggest deleting that portion of the sentence.

The fifth major bullet under highlights, there are no sub-bullets to the topic.

I would delete the first sentence on page 33. It does not add to the topic.

The bullet How likely is an injection operation to pose an induced seismicity hazard?, seems to be missing aspects. For instance what about fault size?

The bullet What is the risk – the probability of harm to people or property, does not touch on frequency. I think it would be helpful to include it here.

Under siting and permitting of new wells, there is mention of proximity to basement rock, but there does not seem to be any mention of pathway for downward migration. If there is a lower confining layer then there is likely less chance for there to be an interaction. I would consider adding a little about pathways.

Under risk mitigation options, second bullet, I suggest adding something about or into formations that have the potential to transmit pressure into the crystalline basement.

On page 38 you list out some options for mitigation. In that list several of them could fall under permit modification, yet you also add permit modification to the list. Permit modification to me is not really a mitigation step. It is one mechanism to get your mitigation approach in use, but it is not really a mitigation approach in its own right.

#### Chapter 4:

The examples that you provide are very helpful. However, it might be informative to also talk about some of the miss-steps.

#### Appendix A:

You mention that “Many scientist have tried many different ways to prediction earthquakes, but there have been few successes.” This implies that there have been some successes. I am not aware of any legitimate earthquake predictions. The Human Anxiety section is a really good addition, but I do not think it belongs in the appendix on earthquake science.

#### Appendix B:

Table B.1 is not accurate. It states that there are zero active Class VI wells. However, there are two active wells in Illinois. Also I do not think the footnote is appropriate. EPA does not make a distinction between commercial and non-commercial for Class VI. Since EPA is currently the only agency that is implementing the program, I think it is inappropriate to make a distinction about commercial or non-commercial.

Under Regulation of Class II disposal wells, there are several mentions about regulators conducting seismic monitoring. This makes it feel like this is a common occurrence. However, I am only aware of a few States that have incorporated this. I would consider revising to reflect more accurate picture.

You also state that regulators are responsible for reviewing Class II disposal well permits, but you never mention that these regulators are also responsible for writing and issuing permits. This fact should be added.

#### Appendix C:

Most of the examples do not do good job of the stated purpose. For example, in the Oklahoma case it states that “... It illustrates the merits of the felt reports submitted to USGS “Did you feel it” system as valuable tool in locating epicenters.” However, in the discussion that follows you don’t really get that sort of sense. What you get is that DYFI

system helped scientists in determining where to place seismometers. Which is different than helping locating epicenters.

In the Ohio case you use abbreviation NS1 before you define the term.

Appendix G:

Figure G-1 could be made a little larger.

On page 103, second paragraph, first sentence. It seems like this is an incomplete sentence.

You use abbreviation BHP before you define the term.

If you have any questions please feel free to contact me.

Cheers

Bill

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**From:** Ben Grunewald [<mailto:ben@gwpc.org>]

**Sent:** Monday, August 24, 2015 1:22 PM

**To:** Mike Nickolaus; [Andrew.adgate@dnr.state.oh.us](mailto:Andrew.adgate@dnr.state.oh.us); [sanderson@edf.org](mailto:sanderson@edf.org); [darthur@all-llc.com](mailto:darthur@all-llc.com); [Scott.ausbrooks@arkansas.gov](mailto:Scott.ausbrooks@arkansas.gov); [Brad.Bacon@pdce.com](mailto:Brad.Bacon@pdce.com); [t.baker@occemail.com](mailto:t.baker@occemail.com); [gerry.baker@iogcc.state.ok.us](mailto:gerry.baker@iogcc.state.ok.us); Bates, William; [rabauer@illinois.edu](mailto:rabauer@illinois.edu); [johnbaza@utah.gov](mailto:johnbaza@utah.gov); [Larry.Bengal@aogc.state.ar.us](mailto:Larry.Bengal@aogc.state.ar.us); [beroza@stanford.edu](mailto:beroza@stanford.edu); [bromhal@netl.doe.gov](mailto:bromhal@netl.doe.gov); [rex@kgs.ku.edu](mailto:rex@kgs.ku.edu); [jeff.bull@chk.com](mailto:jeff.bull@chk.com); [Diana.burn@stata.co.us](mailto:Diana.burn@stata.co.us); [ccabarcas@hilcorp.com](mailto:ccabarcas@hilcorp.com); [tcladouhos@altaroenergy.com](mailto:tcladouhos@altaroenergy.com); [dustin.crandall@netl.doe.gov](mailto:dustin.crandall@netl.doe.gov); Dellinger, Philip; [tdohmen@hess.com](mailto:tdohmen@hess.com); Dorsey, Nancy; [Jon.freedman@ge.com](mailto:Jon.freedman@ge.com); [cliff@ig.utexas.edu](mailto:cliff@ig.utexas.edu); [Rod.Gertson@dvn.com](mailto:Rod.Gertson@dvn.com); Green, Holly; [rob.habiger@spectraseis.com](mailto:rob.habiger@spectraseis.com); [Henry.J.Harmon@wv.gov](mailto:Henry.J.Harmon@wv.gov); [dhenry@hilcorp.com](mailto:dhenry@hilcorp.com); [r.hoffman@kcc.ks.gov](mailto:r.hoffman@kcc.ks.gov); [austin.holland@ou.edu](mailto:austin.holland@ou.edu); [roger.kelley@clr.com](mailto:roger.kelley@clr.com); Kenney, James; [bob.koehler@state.co.us](mailto:bob.koehler@state.co.us); [Joslee.jjl@gmail.com](mailto:Joslee.jjl@gmail.com); [C.Lord@occemail.com](mailto:C.Lord@occemail.com); [Hal.Macartney@pxd.com](mailto:Hal.Macartney@pxd.com); [elmajer@lbl.gov](mailto:elmajer@lbl.gov); [shawn.maxwell@itasca-image.com](mailto:shawn.maxwell@itasca-image.com); [hmcdivitt@dnr.IN.gov](mailto:hmcdivitt@dnr.IN.gov); [lmcdonald@sandridgeenergy.com](mailto:lmcdonald@sandridgeenergy.com); [meadows@api.org](mailto:meadows@api.org); [musick\\_ambrose@msn.com](mailto:musick_ambrose@msn.com); [Mark.Nechodom@conservation.ca.gov](mailto:Mark.Nechodom@conservation.ca.gov); [tnein@hilcorp.com](mailto:tnein@hilcorp.com); [Jeffrey.nunn@gmail.com](mailto:Jeffrey.nunn@gmail.com); [kris.i.nygaard@exxonmobil.com](mailto:kris.i.nygaard@exxonmobil.com); Mike Paque; [john.parrish@conservation.ca.gov](mailto:john.parrish@conservation.ca.gov); [DonaldPA@USC.edu](mailto:DonaldPA@USC.edu); [wriish@hullinc.com](mailto:wriish@hullinc.com); [johnrogers@utah.gov](mailto:johnrogers@utah.gov); [brian.rovelli@ge.com](mailto:brian.rovelli@ge.com); [jrubinstein@usgs.gov](mailto:jrubinstein@usgs.gov); [rupp@indiana.edu](mailto:rupp@indiana.edu); [rjsa@chevron.com](mailto:rjsa@chevron.com); [Jesse.sandlin@dnv.com](mailto:Jesse.sandlin@dnv.com); [Leslie.Savage@rrc.state.tx.us](mailto:Leslie.Savage@rrc.state.tx.us); [fernando.sierra@shell.com](mailto:fernando.sierra@shell.com); [Rick.Simmers@dnr.state.oh.us](mailto:Rick.Simmers@dnr.state.oh.us); [Michael.sims@rrc.state.tx.us](mailto:Michael.sims@rrc.state.tx.us); [dsmith@rexenergycorp.com](mailto:dsmith@rexenergycorp.com); [jsmith@anga.us](mailto:jsmith@anga.us); [Edward.steele1@ge.com](mailto:Edward.steele1@ge.com); [stump@smu.edu](mailto:stump@smu.edu); [LauraSwafford@chevron.com](mailto:LauraSwafford@chevron.com); [Michael.Teague@ee.ok.gov](mailto:Michael.Teague@ee.ok.gov); [Mark.thiesse@wyo.gov](mailto:Mark.thiesse@wyo.gov); [Timothy\\_Tyrrell@xtoenergy.com](mailto:Timothy_Tyrrell@xtoenergy.com); [Bob.vanvoorhees@gmail.com](mailto:Bob.vanvoorhees@gmail.com); [john@veilenvironmental.com](mailto:john@veilenvironmental.com); [randijwalters@gmail.com](mailto:randijwalters@gmail.com); [norm.warpinski@pinntech.com](mailto:norm.warpinski@pinntech.com); [Kara.williams@chk.com](mailto:Kara.williams@chk.com); [jonathan.winsor@shell.com](mailto:jonathan.winsor@shell.com); [Ivan.Wong@urs.com](mailto:Ivan.Wong@urs.com); [brian.woodard2@chk.com](mailto:brian.woodard2@chk.com); [robert.worstall@dnr.state.oh.us](mailto:robert.worstall@dnr.state.oh.us); [Debby.yost@chk.com](mailto:Debby.yost@chk.com); [Ulrich.Zimmer@shell.com](mailto:Ulrich.Zimmer@shell.com); [zoback@stanford.edu](mailto:zoback@stanford.edu); [craig.pearson@rrc.state.tx.us](mailto:craig.pearson@rrc.state.tx.us); [jfurnace@hilcorp.com](mailto:jfurnace@hilcorp.com); [michael.mathis@clr.com](mailto:michael.mathis@clr.com); [jill.cooper@Anadarko.com](mailto:jill.cooper@Anadarko.com); [m.skinner@occemail.com](mailto:m.skinner@occemail.com); [Diana.Burn@state.co.us](mailto:Diana.Burn@state.co.us); [Jesse.Sandlin@dnv.com](mailto:Jesse.Sandlin@dnv.com); Coleman, Margaret; Courtney Murphy; Gerry Baker; Zeeshan Syed  
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**Subject:** Final primer courtesy read

Induced Seismicity Workgroup Members and Technical Advisors—

On behalf of the GWPC, IOGCC and the Editorial Committee of the Induced Seismicity Work Group, I want to THANK YOU for your participation and patience as we are nearing the end of the development of the Induced Seismicity Primer.

We have received many great comments and suggestions regarding the many details of the document and have considered and appreciated every one, however as you would assume with so many involved, not every suggestion will be included. Please see the Dropbox link to the DRAFT FINAL version and note this brief courtesy review period will be your final opportunity to see the document prior to its September 28 release.

<https://www.dropbox.com/s/e83nagdsr6v4l8v/ISWG%20Primer%20V%205.1%20EC%20Review.docx?dl=0>

Please do not wordsmith this version BUT rather let us know if you see specific inaccuracies or show stoppers no later than one week from today, at noon CT, August 31<sup>st</sup>.

Thanks again!  
Ben Grunewald  
ISWG Coordinator  
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